

## CLAIMS

What is claimed is:

1. Method for forming solder bumps on a substrate having a plurality of pads on a surface thereof, comprising:

providing a mask having a first surface and a second surface, and a plurality of cells extending from the first surface at least partially through the mask to the second surface thereof;

filling the cells with solder paste;

disposing the substrate in a biased chuck assembly;

disposing the mask on the surface of the substrate with the first surface of the mask adjacent the surface of the substrate;

urging the substrate into positive contact with the mask so as to maintain substantially intimate contact between the first surface of the mask and the surface of the substrate;

reflowing the solder paste; and

separating the substrate from the mask.

2. Method, according to claim 1, wherein:

the solder bumps are solder balls.

3. Method, according to claim 1, wherein:

the substrate is a semiconductor wafer.

4. Method, according to claim 1, wherein:

the chuck assembly includes a diaphragm; and

further comprising:

introducing a gas at positive pressure to cause the diaphragm to deflect upwards to urge the substrate into positive contact with the mask.

5. Method, according to claim 1, wherein

the cells extend completely through the mask from the first surface thereof to the second surface thereof.

6. Method, according to claim 5, further comprising:  
prior to reflowing, closing the cells of the mask.
7. Apparatus for forming solder balls on substrates comprising a chuck assembly, said chuck assembly comprising:  
a rigid, generally planar chuck base having a cavity extending into the chuck base from a top surface thereof,  
a generally planar, flexible diaphragm extending across the cavity and secured to the chuck base;  
said cavity being sized and shaped to receive the diaphragm.
8. Apparatus, according to claim 7, further comprising:  
an inlet tube extending from exterior the chuck base to within the cavity, underneath the diaphragm.
9. Apparatus, according to claim 7, further comprising:  
a permeable substrate disposed beneath the diaphragm, between the diaphragm and a bottom surface of the cavity.
10. Apparatus, according to claim 9, wherein:  
the permeable substrate comprises such as a powdered metal plate.
11. Apparatus, according to claim 7, wherein:  
the diaphragm comprises a sheet of silicon rubber material.
12. Apparatus, according to claim 7, further comprising:

a generally planar, flexible manifold element;

a recess, coaxial with and larger than the cavity, extending into the chuck base from the top surface thereof, said recess being sized and shaped to receive the manifold element.

13. Apparatus, according to claim 12, wherein the manifold element has a top surface and a bottom surface and comprises:

a plurality of grooves extending across the top surface of the manifold element;

an opening extending from the top surface of the manifold element through to the bottom surface of the manifold element, and the opening is aligned with an inlet orifice in the chuck base.

14. Apparatus, according to claim 13, wherein:

the plurality of grooves comprise two parallel sets of intersecting grooves.

15. Apparatus, according to claim 12, wherein:

the manifold element extends across the recess, and is secured to a top surface of the diaphragm.

16. Apparatus, according to claim 12, wherein:

the manifold element comprises a sheet of a film material.

17. A chuck assembly for holding a semiconductor wafer in intimate contact with a mask, comprising a rigid, generally planar chuck base, characterized by:

a central recess extending into the stage from a top surface thereof, said recess sized and shaped to receive a generally planar, flexible diaphragm, said diaphragm extending across the recess.